*Environmental Health Perspectives*
*Vol. 13, pp. 1–3, 1976*

# Soviet-American Cooperation on Fundamental Problems in Environmental Health

## by David P. Rall*

In this overview I want to first discuss briefly the needs for environmental health research; secondly, the needs in environmental health research; and lastly, discuss how the U.S.–U.S.S.R. Cooperative Program, in being responsive to these needs, has developed over the first two years of its existence.

Intrinsic to our modern civilization are a great many forces, events, developments, and circumstances which are constantly increasing the need for research efforts in environmental health. Paramount among these forces is the development of a sophisticated complex chemical process industry in the last 20 or 30 years. The industrial revolution of the last century was largely concerned with the remaking, re-forming and re-shaping of raw materials into finished products. While there were aspects of environmental pollution involved in this process, they tended to be of a less serious nature. Our modern chemical process industry, however, is involved in the production of totally new and unique chemical compounds to which man has never been exposed before. There are an increasing number of these compounds. In the United States it is estimated that there are between 500 and 1000 new chemical compounds introduced in commercial quantities each year. These compounds affect society in a surprising variety of ways. There is, first of all, the exposure of workers in the occupational environment in which these compounds are created. The effluents from the manufacturing plants can lead to pollution of the water or the air. The transport of these materials to processing plants can also lead to pollution of water, air, or land areas adjacent to the transportation routes. Sometimes the final product may have hazardous aspects. The problems one faces in this area can often be totally unexpected. For example, it has become apparent very recently that halogenated hydrocarbons—known in the United States as freons and which are used as refrigerant compounds and as propellant gases in aerosol spray cans—are entering our atmosphere at an increasing rate. Some responsible scientists have predicted that within a matter of a few decades there will be a significant interaction between these freons in the atmosphere and the ozone layer which protects the earth from the intense ultraviolet radiation coming from the sun. A diminution in this ozone layer would significantly increase the ultraviolet exposure of the entire earth and could have consequences of enormous impact upon man and his civilization.

One important sector of the developing chemical process industry makes possible intensive cultivation of land for agricultural purposes, but the intense and long-term use of pesticides, herbicides, fertilizers, and so forth, can lead to significant undesirable environmental impacts as well.

A second major factor increasing the need for research efforts in environmental health is the constantly increasing use of energy in the United States, in the Soviet Union, and throughout the world. There are a very great number of problems implicit in our constantly increasing demand for energy in all of its forms. Critical problems include the sulfur oxides and particulates in air, and the problems of hydrocarbons—which are potentially carcinogenic and mutagenic—that come from incomplete combustion, from coal liquification or gasification, or even can enter the marine biota from oil spills in the ocean. Another problem, arising from the increased burning of coal particularly,

*National Institute of Environmental Health Sciences, P. O. Box 12233, Research Triangle Park, North Carolina 27709.

is the discharge into the atmosphere of a variety of heavy metals of known and serious toxicity.

A third factor, perhaps more subtle than the others, which supports the need for more environmental research is the constantly increasing urbanization of modern civilization. As one moves from a predominantly agrarian economy with very small towns and widely dispersed populations to the intense development of a Moscow, or a Leningrad, or a New York City, or a Los Angeles, the higher volume of effluents from industrial and commercial operations and from residences results in the exposure of larger numbers of people. This creates problems that would not be so severe were the industries or population distributed over many square miles of the countryside.

Although we all enjoy the fruits of modern civilization and the developing technology which has allowed us to increase our standards of living to heights that were scarcely believable two or three decades ago, we must face the problems arising from the growing presence of toxic pollutants in all sectors of our environment.

The question then is "How must we as environmental health scientists respond to these growing problems in environmental pollution?" I would suggest that there are certain clearly defined needs in environmental health research. I will mention four of these needs. There are certainly others, and I do not feel this list is inclusive or in any particular order of priority.

The first need, as I see it, is to understand what toxicity tests in animals mean in terms of human exposure. This is an absolutely basic question. We must pretest compounds before the human population is exposed. Typically, our methods for pretesting compounds involve the use of laboratory animal test systems. We must understand what the data obtained from these test systems mean, not only to the human population in general, but to various groups within the population which may be more sensitive. There are two aspects of this: the qualitative, which asks the question, "How well do the test systems predict the nature of the toxic effects which would be observed in man?"; and the second, the quantitative question, "How well do these test systems predict the concentration or dose of the pollutant which would cause damage to man?" The significance of animal tests, or to put it another way, the validity of extrapolating laboratory animal test results to man, is of major importance in environmental health research.

Second, we must understand basic toxicological relationships. By this broad statement I mean that we must understand two things: the mechanism of toxicity and the relationship of biological structure to activity. In other words, we must understand how an agent, whether it be a chemical or a physical force in the environment, causes damage to molecules, cells, or tissues, which then becomes expressed as an injury or toxicity to that animal or individual. If we can understand the mechanisms leading to toxicity, we can then begin to construct an overall understanding of the mechanism of the toxicity of related agents. Similarly, we must understand in a more comprehensive manner structure–activity relationships of related compounds. That is, how do easily measured physical–chemical characteristics of a series of compounds relate to biological activity? By understanding mechanisms and structure–activity relationships, when a new compound appears on the scene we will be in a position to predict its toxicity without the delays and expense of extensive laboratory animal tests.

Third, we must understand interactions between apparently dissimilar compounds. Synergistic toxicity, as it is called in the United States, has been shown to be of major importance in therapeutic drugs. Examples are just beginning to appear suggesting the possibility that two environmental agents, each of modest toxicity, could cause greatly enhanced toxic response when an individual is exposed to both simultaneously. There are many problems in understanding synergistic toxicity, and yet it is clear that we live in a world that is literally a sea of environmental pollutants.

Fourth, we must develop more rapid test methods. At least in the United States, a standard and complete toxicological test takes between two and three years and consumes a very large quantity of dollars and highly specialized manpower. It is literally impossible to test all of the compounds that are produced in commercial quantity each year in the United States by this classic method. We must, therefore, develop new, more rapid, but still effective, test methods.

I think the U.S.–U.S.S.R. Cooperative Research Program in Environmental Health reflects our appreciation of the needs for research in this area and the research needs that we believe are the most important. The papers presented by my American colleagues and by my Russian colleagues illustrate very well indeed the research accomplishments of the past two years; and I shall not attempt to discuss them at this time. What I think is more important is the fact that we have been able to cooperate in an effective and friendly manner over these last two years. If one wished to exemplify the obstacles

to collaboration which we have had to overcome, one need only begin with an attempt to translate the National Institute of Environmental Health Sciences into the Russian language and the Institute of General and Communal Hygiene into English. The gap that has existed between American and Soviet scientists in this area over the past has been great indeed and we have begun, slowly and steadily, and with good faith and good humor, to close this gap; in the long run, this may prove to be considerably more important than the very significant, very interesting research findings presented by our scientists.